

Project Title: “Natural Attenuation of Arsenic in an Urban, Industrialized Watershed”

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Introduction to the Problem: The natural attenuation of contaminant metals within a watershed is controlled by processes that sequester the metal from solution to immobile soil or sediment solids. Observation of arsenic cycling in natural systems suggests that partitioning to iron (hydr)oxide minerals may immobilize arsenic within soils and sediments. The proposed research explores the extent of this attenuation process within an industrialized watershed impacted by arsenic contamination from historical industrial activities. The study combines field and laboratory studies designed to 1) determine the geochemical processes that control aqueous and solid phase arsenic speciation and 2) evaluate the most reliable methods and practices for sample collection, preservation, and characterization. The results of this research will aid in the overall development of assessment criteria and practices for determining the potential for attenuation of arsenic via partitioning to soil and sediment matrices.

Background: Arsenic contamination from historical industrial disposal activities and pesticide applications poses a threat to ground and surface waters throughout the United States. However, assessment of the long-term threat of arsenic at a watershed scale requires knowledge of the physical and chemical processes that influence arsenic mobility. Attenuation of arsenic may occur under certain settings through partitioning of aqueous arsenic to immobile solid phases within soil or sediment. In natural systems, sequestration of arsenic by iron (hydr)oxide minerals provides a potential long-term sink for soluble arsenic. Previous research has shown that the mobility of arsenic is influenced by perturbations in pH and redox status in aqueous systems. Changes in these geochemical parameters influence arsenic oxidation state and the dissolution-precipitation behavior of iron (hydr)oxide minerals. Development of a rationale approach to assess the potential for natural attenuation of arsenic within a watershed thus requires 1) understanding the primary geochemical processes that cycle arsenic and iron between the aqueous and solid state and 2) identification of the most reliable tools and practices for measurement of key geochemical parameters. To address this need, research is being undertaken in cooperation with the Region I EPA office to study the extent and mobility of arsenic contamination with an industrialized watershed in Massachusetts.

Objectives: To assess the potential for natural attenuation of arsenic within an industrialized watershed.

Approach: The goals of this research are 1) to assess the geochemical processes that control arsenic mobility in the Aberjona watershed, 2) to develop methods for characterizing solid phase arsenic speciation, and 3) to develop guidance for the assessment of natural attenuation on remediation of arsenic in soils and sediments. These goals will be addressed through field and laboratory studies. Assessment of arsenic mobility in a contaminated watershed will be carried out at the Industri-Plex Site in Woburn, Massachusetts, and the wetland immediately adjacent to the industrial site. Water, soil and sediment samples will be collected by hand, Geoprobe techniques, or through establishment of temporary wells. Aqueous geochemical parameters will be measured on-site and in the laboratory, and soil and sediment materials will be collected for characterization in the laboratory. Laboratory studies will be conducted to develop methods to speciate solid phase arsenic and to establish the reversibility (mobilization potential) of arsenic partitioned to soil and sediment materials.

Accomplishments to date (August 2003): Field monitoring over a two-year period has been completed. Data for ground water and surface water has been compiled and a draft project report was submitted for review to USEPA Region 1.

Near future tasks: Characterization work is being conducted on contaminated soils and sediments to assess arsenic chemical speciation and leaching potential. A final report will be submitted to Region 1 and an USEPA Document, entitled ‘Assessment of the Natural Attenuation of Arsenic in an Urban Industrialized Watershed’, will be published in FY04.